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Maine Department of Environmental Protection
Bureau of Land & Water Quality
Division of Land Resource Regulation
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Subject: Comments by Ebbing and James on Draft Order, Application of Record Hill

Please accept the following comments on the Draft Order, for the Application of Record Hill. They are being submitted on behalf of Concerned Citizens To Save Roxbury, and other interested parties, Steve Thurston, Linda Kuras, Colleen Martineau, Anne Morin, Cathy Mattson, Steve Thurston, Lester Thurston, Ron and Chris Dube, Tom and Michelle Currivan, Mike Ronin, Matt Towle, Tony DeSalle, Angie Arsenault, the Silver Lake Camp Owners Association

The comments are submitted in the form of MDEP statement (numbered) with our response provided below the quoted text from the draft decision.

1. First, interested parties raised concerns regarding the human health effects and sleep disturbance linked to infrasound and low frequency sound less than 250 Hz from wind turbines. Infrasound is sound that is generally considered to be less than 20 Hz, the normal limit of human hearing.

   Response: No disagreement

2. In response to the interested parties' submissions, EnRad stated that infrasound has been widely accepted to be of no concern below the common human perception threshold for tonal sounds. The Department finds EnRad's comments to be credible, and that there is insufficient evidence to conclude otherwise.

   Response: On what basis does the Department conclude that EnRad is an authority on this subject? We would accept that the Wind Industry and its trade organizations like AWEA make this same claim. But, they are not an authority either. The basis for this premise appears to go back to a statement by Dr. Geoff Leventhal, circa 2004 or 2005 that was subsequently widely circulated by the British Wind Energy Association and later by the American Wind Energy Association. That statement, in one of its forms, implies that wind turbines do not emit "significant" infra and low frequency sound (ILFN) implying that to be "significant" the levels have to be above the threshold of perception.

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It should be understood that Dr. Leventhall is a highly respected acoustician. But, he is not a medical doctor. As an acoustician, he has participated in numerous research studies into the affects of ILFN. Some of these studies were concerned with noise inside office and other large buildings where the HVAC system is a potential source of infra and low frequency sound, if not properly designed and constructed. These studies found that inaudible low frequency sound that exhibits amplitude modulation caused people to be less productive and to have other adverse effects. In 2004, Dr. Leventhall was the lead researcher on a study into the effects of ILFN for the British government (DEFRA Report). That report concluded that wind turbines did produce ILFN and that ILFN at levels common in some community can result in adverse health effects. There is no indication of how his prior research which had reported adverse health effects from ILFN and linked them to wind turbines had been overturned to result in the statement to the contrary that the BWEA circulated in 2005 or thereabouts. One study in which he participated reported:

> "The exposure to low frequency noise resulted in lower social orientation "... "more disagreeable, less co-operative, helpful, and a tendency to lower pleasantness."... "more bothered, less content, as compared to the mid-frequency noise exposure. Data from test III may indicate that the response time during the last part of the test was longer in the low frequency noise exposure. The effects seemed to appear over time. The hypothesis that cognitive demands are less well coped with under the low frequency noise condition, needs to be further studied. The results further indicate that the NC curves do not fully assess the negative effects of low frequency noise on work performance."
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> From: "Effects On Performance And Work Quality Due To Low Frequency Ventilation Noise, K. Persson Waye, R.Rylander, S.Benton, H. G. Leventhall; *Journal of Sound and Vibration* "0886# 194"3#\ 356_363

A simple search of online libraries of science papers on the effects of infra and low frequency sounds would find numerous similar papers. Many relate to the problems caused by ILFN from HVAC systems. For example, the excerpt above lists the multiple adverse physical and psychological effects caused by working in a room with high low frequency sound levels that were at 45 dBA. This is the same sound level that MDEP and MCDC apparently consider to be free of adverse health effects.

If there are no adverse effects from ILFN then why has the HVAC industry put so much effort into preventing it in office buildings? It is <u>because of the adverse health effects from ILFN that the HVAC industry has supported so much research into how to predict it and prevent it</u>. Because of its adverse effects on people they had to be able to predict whether unacceptable low frequency rumble would occur inside building spaces in the planning stages. Building occupants, particularly knowledge workers, have been unwilling to occupy buildings with excessive rumble (that is, low frequency noise).

Room Noise Criteria were developed to permit acoustical consultants and other practitioners to determine what noise reduction was necessary to prevent rumble. When these criteria are applied to sound data taken inside homes where people complain of symptoms similar to those in the above quoted study the home interiors are found to exhibit excessive rumble of the type associated with worker complaints.

The HVAC industry and its acoustical consultants have known of the problems and how to prevent them since the early 1980's. However, it seems apparent that ***either the Wind Industry doesn't know, or if it does, it has not seen fit to be transparent with the public on this issue.***

This lack of interest by the wind industry in research into ILFN in other fields is one of the more troubling aspects of the situation. It seems that all efforts are placed on denying the possibility of a problem instead of showing an interest in why there are so many complaints from people near operating wind projects. This has led to the current situation where a problem related to the health and welfare of Maine's citizens is permitted to be repeated because the real information on adverse health effects from ILFN are buried under an effective public relations and social marketing campaign. Under this scenario, currently supported by MDEP and MCDC, people are being put at risk on an ongoing basis at operating wind projects like Mar's Hill and similar risks will be imposed on the citizens near Record Hill if MDEP's decisions stands unchanged.

In spite of denials by EnRad, MDEP, and MCDC to contrary, there is also substantial evidence that infra and low frequency sounds can cause adverse health effects at levels below the threshold of perception for sounds from recent medical studies. This includes many that are fully peer reviewed. Several such studies have been previously submitted to the record.

These studies are not just focused on ILFN from wind turbines. They include studies showing adverse health effects for people living near highways, working in airports, and many other situations where long term exposure to ILFN that was previously believed to pose no health risks.

Somehow, EnRad, MDEP and MCDC have missed an important piece of information. ILFN <u>can</u> cause adverse health effects even at levels that are below the audible threshold of perception. Whether this has occurred from lack of a thorough literature search, an over reliance on information from the wind industry and its supporters, a problem understanding the information that has already been provided for the record, or because the Agency's are willing to "bend the rules" to satisfy the Administration and Legislature's goals is impossible to determine. But, the fact that this has occurred, puts citizen's of Maine at risk.

3. Numerous national infrasound standards limit industrial facilities, impact equipment and jet engines, but wind turbine infrasound levels fall below these standards.

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Response: See above. Knowledge of the efforts to reduce ILFN in the HVAC industry shows that this is not true. Also, new research is extending the information about the effects of ILFN on people and as this knowledge spreads it is applied to making such standards more restrictive. That is the process that is occurring now in Maine. Wind turbines produce much higher levels of ILFN than many people understand. The fact that it is not audible makes it difficult for many to appreciate the adverse health effects that occur in a small portion of the people exposed to it..

4. The Maine Center for Disease Control (MCDC) within the Department of Health and Human Services (DHHS) reviewed the materials submitted by interested parties pertaining to potential health effects associated with wind turbines. MCDC stated that, interference and noise-induced hearing loss is not an issue when studying the effects of noise from wind turbines because the exposure levels are too low. The MCDC found no evidence in peer-reviewed medical and public health literature of adverse health effects from the noise generated by wind turbines other than occasional reports of annoyances.

   Response: See above.

5. Most studies on the health effects of noise have been done using thresholds of 70 dBA or higher outdoors, much higher than wind turbines typically generate. With regard to sleep disturbance, the World Health Organization (WHO) guidelines for community noise recommend that outdoor noise levels in living areas for nighttime not exceed 45 dBA, which is consistent with Maine law.

   Response: Can the MDEP supply any research supporting its claim that most studies on the health effects of noise have been done using thresholds of 70 dBA or higher outdoors? We find that there is considerable research on low level sound and community response. For example, the World Health Organization conducts intense research into the effects of noise on communities and find that when outdoor sound levels are in the range of 40 to 55 dBA outside a home:

   > "There is a sharp increase in adverse health effects, and many of the exposed population are now affected and have to adapt their lives to cope with the noise. Vulnerable groups are now severely affected."
   > From: World Health Organization, 2007 Night Noise Guideline (NNGL) (an update to the 2000 Guidelines)

   It would seem that the MDEP's claim about the lack of research into community sound levels of less than 70 dBA is not correct. There is considerable information of the effects of outdoor noise, both with and without ILFN and adverse health effects available in scientific papers and from organizations such as WHO.

   Further, MDEP also overlooks the fact that they are relying on an outdated WHO document and taking only one element of in its attempt to support its current rules. In the earlier WHO Guidelines (Berglund, et.al.) based on data available in 1999 to which MDEP refers there was a cautionary note in the same text where 45 dBA outdoors is mentioned that warns that if significant low frequency noise is present a

better assessment of the health effects would require using dBC weighting and an indoor criteria of less than 30 dBA. However, in 2007 WHO revised its guidelines and the new WHO criteria are significantly more restrictive than the limits in effect in Maine.

If this discussion was about urban or suburban areas were nighttime sound levels may be 35 to 45 dBA or higher from 'urban hum' then there might be less concern. But, the existing background sound levels in rural areas inside proposed wind projects ***at night*** are typically ***20-30 dBA***. Under the MDEP decision process, wind turbines are permitted to produce ***45 dBA on a 24/7 basis at the homes and properties of people who previously enjoyed peace and quiet.***

Given that in its 2007 Guidelines, WHO has updated its prior recommendation of 30 dBA in a sleeping room/45 dBA outdoors to be $L_{night\text{-}outside}$ of 30 dBA; it would be appropriate for MCDC and MDEP to reconsider its position also on the acceptability of 45 dBA outdoors for Maine's citizens. The new guidelines call for outdoor sound levels to be 30 dBA or less <u>outside</u> to avoid adverse health effects from night time noise.

6. Second, the interested parties stated that the applicant did not correctly predict the 45 dB nighttime limit at protected locations, and point source measurements should have been used rather than line sources. In response to this concern, EnRad stated that sound sources can vary widely in their arrangement and complexity, and that dB should not be confused with dBA. The argument 3 dB/6 dB may apply for sound power level of an infinite line source, but not for sound pressure level (A-weighted) of this finite quasi-line source. At times it may be convenient and sufficiently accurate to approximate a multiple source arrangement into a single simplified configuration, e.g. point source, infinite line source or infinite plane source; however, it is often tenuous or impossible to base calculations on each individual source of a particular configuration or array. When applied correctly, point source and line source measurements produce the same data. A difference in data may occur only in instances where topography is consistently level. EnRad further stated that the applicant's sound level model provides sufficient accuracy for the given situation.

   Response: First, we have no idea who is confused by dB versus dBA, but it is not our situation or problem. We understand acoustical engineering and collectively represent almost 100 years of experience. This experience leads us to conclude that the argument in the above section of MDEP's decision is little more than contrived nonsense. EnRad's position, as represented by MDEP, seems to be that calculations using point sources and line sources would both result in the same sound levels at some specified distance to the side of the array of turbine. This is absurd on its face.

   The formulas for point source and line source propagation are not going to yield the same results. The difference in decay rates is because line sources, which are indeed point sources when by themselves, interact with each other's sound emissions to reinforce each other. Thus, the spread of sound from a line of point

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sources is cylindrical, not spherical. The total energy emitted is the same in both cases but the reinforcement due to the linear arrangement causes sound to spread as a cylindrical surface not a sphere. Cylindrical areas increase in proportion to the square of the radius from the source, whereas spherical surfaces areas increase in proportion to the square of the radius. The arrangement of the point sources into a row causes reinforcement that changes the decay rate from 6 dB to 3 dB. The point source model does not consider this reinforcement so it will not produce the same predictions.

We agree that this is a complex area of engineering, but it is one that has been addressed by acoustical engineers since long before the advent of computer models such as Cadna/A. When a situation is too complex for the commercial computer model to address it properly there are still other, manual methods available for making these calculations.

EnRad's conclusion that the models used in predicting wind project noise propagation are adequately accurate appears to be equally specious and contrived. Numerous papers are published on ways to improve the accuracy of computer models for particular types of noise sources. Many papers have been published and presented on the need to interpret computer models carefully. All models are grossly simplified representations of complex environments. There are known errors and tolerances that amount to about 5 to 10 dB of potential error for even the simplest of models that fit the assumptions of the underlying algorithms. Wind turbine projects are anything but simple and they do not fit the underlying assumptions of the ISO standards upon which they are based. To claim that any such model is accurate enough to be used without an assigned tolerance for errors reflecting those known limitations is not in line with how models are viewed by other engineers or scientists.

Assume that a model predicts a sound level of 45 dBA at a home and that for this case 45 dBA is the permitted limit. It appears that MDEP is ready to accept that predicted 45 dBA as though it was precise. It is not. It should be viewed as any other type of measurement or model and used with tolerances. Thus, if the tolerance for a computer model of Record Hill is ± 5 dB (for known errors in modeling and measurement of sound power levels) and the model predicts 45 dBA the results should be expressed as 45 +5 dB or 50 dB for permitting purposes. This is appropriate and customary for all other scientific work. Why does MDEP and EnRad believe it is unnecessary for models of wind turbine projects?

7. Chapter 375 §10 standards are applied using the A-weighted scale, which is widely used in noise ordinances and sound control regulation. The Department finds that the applicant adequately applied the A-weighted scale when modeling estimated sound levels for the proposed project pursuant to Chapter 375 §10.

   Response: See above.

8. Short Duration Repetitive (SDR) Sounds. Interested parties stated with documentation that the applicant's noise analysis failed to make an allowance for SDR sound, specifically, the

thumping noise produced by the turbine blades. Maine's noise regulations require a 5 dB penalty to be added to the predicted sound level to adjust for this type of repetitive sound. A review of studies shows that 5-6 dB is common and 10-15 dB is possible.
SDR sounds are a sequence of sound events, each clearly discernible, that cause an increase of 6 dBA or more in the sound level observed before and after an event. SDR sound events are typically less than 10 seconds in duration and occur more than once within an hour. Published studies of noise from wind turbine operations indicate that sound levels can fluctuate over brief periods as noted by the passage of wind turbine blades and typically range from 2 to 4 dBA. The applicant stated that operations of the proposed project are not expected to result in the 6 dBA increase required to be SDR sounds as set forth in Chapter 375.10
In response to the interested parties' concerns, EnRad commented that the position stated by the interested parties is not a widely accepted fact, and the applicant's noise analysis is reasonably and technically correct. EnRad further stated that predicted sound levels including tonal and short duration repetitive sounds are below Department sound level limits.

Response: During the course of this case it has been shown that SDR's measured using dBA_{fast} as required my MDEP rules are a characteristic of all modern upwind turbines. As EnRad and MDEP acknowledge there are many studies showing that wind turbines produce short duration repetitive sounds (amplitude modulation) with a 5 to 6 dB difference peak to valley. Those studies also show that higher levels of fluctuation in the range of 10 to 15 dB are possible. Given that these studies include many by independent researchers with no economic ties to the wind industry how is it that the MDEP can overlook them and conclude that a penalty for SDR is not appropriate? Does the developer understand something about how to suppress blade swish that is not known to other wind utility operators? This is highly doubtful. It appears that the unsupported claims of the developer that, for Record Hill, this will not occur carries more weight than that of the independent experts.

SDR's of 10 to 15 dB occur frequently late at night when they are most likely to cause sleep disturbance. The MDEP rules for short duration repetitive sounds states that the penalty should be applied if the SDR's can lead to risks to public health. Sleep deprivation leads to health problems. That is why it is classified as a form of torture. Moreover, SDR's from wind turbine blade swish has been identified as normal by-product of the operation of turbines. Its causes are well understood by blade designers. Blade swish results when the blade operating parameters are not optimum and produce turbulence during some part of the rotation. These events clearly meet both the spirit and intent of the rules for applying the 5 dB penalty.

Finally, EnRad states that the position of the interested parties is not a widely accepted fact. How does this enter into the decision? The advisors to the "interested parties" are experts in acoustical engineering. They are few other independent qualified acoustical consultants who are working in this area. Most acoustical consultants who are familiar with the details of this area are working for

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the wind industry and cannot be viewed as disinterested parties in making any claims about noise or health effects from wind turbines.

9. While the sound modeling techniques used by the applicant are in keeping with standard industrial sound modeling protocols, the Department finds that there is sufficient concern related to the model's ability to accurately predict SDR sounds to require the applicant to implement the assessment plan referenced above. If the compliance data indicates that, under most favorable conditions for sound propagation and maximum amplitude modulation, the Record Hill Wind Project is not in compliance with Department standards as described above, within 60 days of a determination of non-compliance by the Department, the applicant must submit, for review and approval, a revised operation protocol that demonstrates that the project will be in compliance at all the protected locations surrounding the development.

Response: We support the Department's concerns about the sound modeling accuracy. However, these concerns do not seem to be well connected to the suggested method for addressing them. The discussion above shows that the authors of this set of comments have sincere doubts about whether the MDEP has taken a rigorous scientific approach to its decision making process or whether political expediency may be a more important factor in its determinations. Given that the MDEP has admitted it has concerns about limitations in modeling and that it acknowledges that wind turbines can produce short duration repetitive sounds (e.g. to blade swish) it would seem that the appropriate conclusion would be to require that the project be put on hold until it can be determined whether there are alternatives to approving the project as it is currently proposed. It is too late to do anything after the wind utility is operating. When the MDEP says the applicant will be required to submit a revised operation protocol. Does the MDEP know if such a possibility exists? Will the wind utility be required to turn the turbines off at night to avoid sleep disturbance? If there are alternative 'revised operation protocols' that may be called upon after the problem is identified, what are they and why are they not being considered prior to approving the application?

----------END of COMMENTS--------

Thank you for considering our comments.

Sincerely,

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